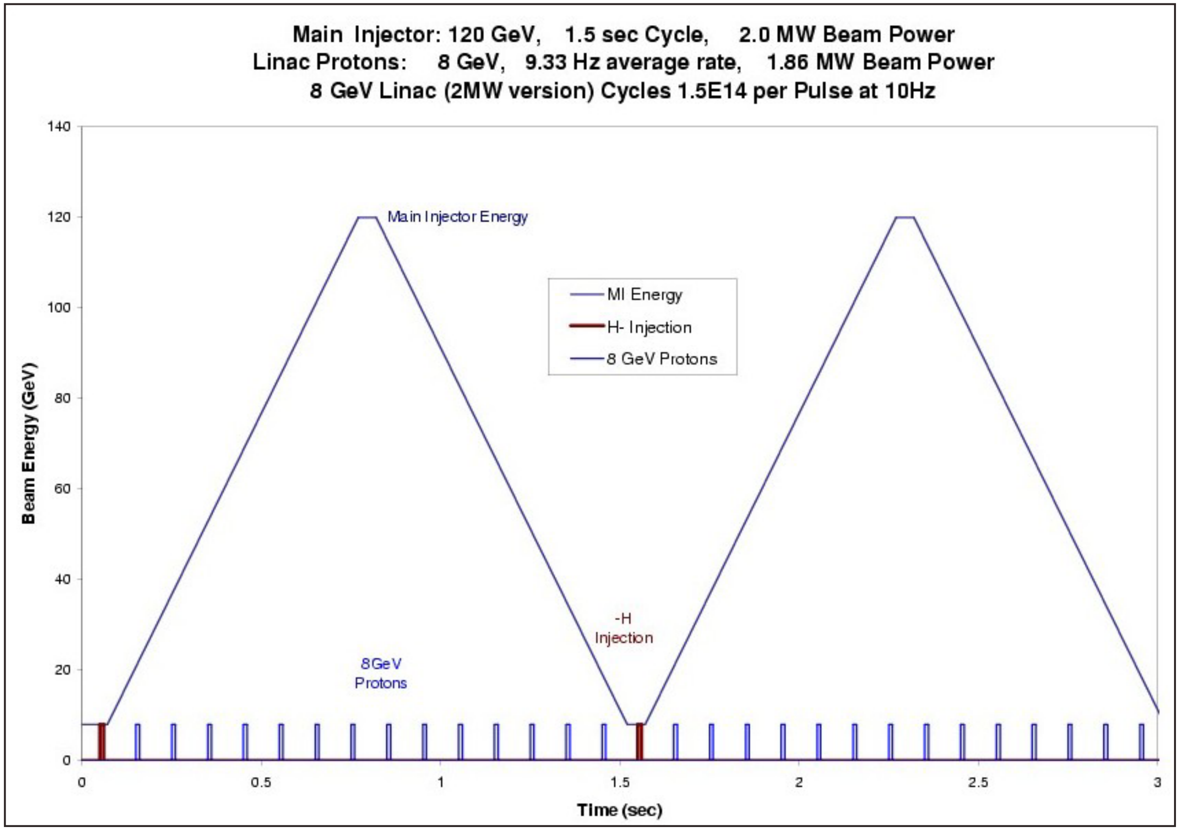
Proton Economics & Sub-Program Compatibilities

Number of Protons vs Beam Power - 1



8 GeV Linac provides 1.5×10^{14} protons/pulse

<u>Presently favored scheme</u>: Linac cycles at 2.5 Hz, with an upgrade to cycle at 10 Hz.

The MI takes one Linac pulse every 1.5 sec, & hence accelerates 1.5×10^{14} protons to 120 GeV every 1.5 secs.

Number of Protons vs Beam Power - 2

1.5×10^{14} protons at 120 GeV every 1.5 secs corresponds to 2MW on target

The 8 GeV and 120 GeV programs can run together:

8 GeV Linac			POT / 10^7 secs	
Cycle Time	Beam Power	Protons per 10^7 s	8 GeV Program	120 GeV Program
2.5 Hz	0.5 MW	3.8×10^{21}	2.8×10^{21}	1×10^{21}
10 Hz	2 MW	1.5×10^{22}	1.4×10^{22}	1×10^{21}

For comparison:

NuMI with 0.25 (0.4) MW $\rightarrow$ 1.3 (2) $\times 10^{20}$ protons/ 10^7 secs

MiniBooNE with ~36 KW $\rightarrow$ 2.5×10^{20} protons/ 10^7 secs

(Note: 8×10^{18} protons/week $\times$ 42 weeks = 3.4×10^{20} protons / year)

Compatibilities

To understand which sub-programs are compatible or incompatible we need some design work on the interface between the beam and the experiments … beam matching etc (everyone wants a different bunch structure, for example)

However, there are a couple of things that can be said …

Kaon Program at the MI

Mode	Sample	Physics	Number of Protons on Target
$K^+ \to \pi^+\nu\nu$	1000	3% $(V_{ts}{}^*V_{td})$	1.5×10^{20}
$K_L \to \pi^0\nu\nu$	1000	1.5% $\mathrm{Im}(V_{ts}{}^*V_{td})$	1.6×10^{21}
$K_L \to \pi^0 ee$	$2\text{x}10^4$	10% $\mathrm{Im}(V_{ts}{}^*V_{td})$	2.5×10^{20}
$K_S\text{-}K_L \to \pi^0 ee$	5×10^5	10% $\mathrm{Im}(V_{ts}{}^*V_{td})$	5×10^{23}

Needs slow spill, which is in conflict with the neutrino program which needs fast extraction. A second ring can resolve the conflict. A $K^+ \to \pi^+\nu\nu$ experiment receiving 1.5×10^{20} POT could be done with slow spill in a few months dedicated run, or a longer run with fast extraction to a bunch-stretcher and a 10% tax on the ν program. In contrast, $K_L \to \pi^0\nu\nu$ presumably would require a second ring & lots of running

Pion Program at 8 GeV

The feeling amongst the pion enthusiasts at our October Workshop was that the pion program requires a modest number of POT.

The Pion/Kaon group is working on producing a table summarizing number of POT required for various pion measurements … the tricky bit is understanding the relevant efficiencies. We are hoping to have the desired table in a couple of weeks.

Muon Program at 8 GeV

We know how many low energy muons we can produce/year, but until we have designed a muon source, we do not know the efficiency for utilizing the muons … except for stopped muons:

Brice, Geer, Paul & Tayloe

	FNAL 2 MW at 8 GeV	SNS 1.4 MW at 1.3 GeV
P/yr	1.6×10^{22}	6.7×10^{22}
DAR (ν/p)	1.5	0.13
DAR (ν/yr)	2.3×10^{22}	0.92×10^{22}
ν_e Events/yr	8900 ε_{REC}	3500 ε_{REC}
ν_μ Events/yr	1500 ε_{REC}	600 ε_{REC}
ν_μ Events/yr	3200 ε_{REC}	1200 ε_{REC}

Neutrino production from Decays At Rest

Event rates for a MiniBooNE-like detector at L = 60 m *(scaled from G. Van Dalen nucl-ex/0309014)*

How to Proceed on Understanding the Muon Program at 8 GeV

We need to design and cost the source. This probably requires a director-sponsored study with some engineering support.

The interface between the muon source and the experiment is experiment-dependent. The source design work must include the design of the interface (beam matching) for the most promising experiments.